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PACKAGING CODE

PART I FACTORS AFFECTING THE SELECTION OF PACKAGING

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Indian Standard

PACKAGING CODE

PART I FACTORS AFFECTING THE SB-ECTKMI OF PACKAGING

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 28 January 1982, after the draft finalized by the Packaging Code Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

0.2 The aim of the packaging code is. to provide a source of information on the methods and materials used in packaging, and to provide guidance as to how they should be selected and used. Such guidance can, however**,** be given only in general terms since the packaging requirements of any two products may differ fundamentally and no two products will be precisely identical.

0.3 The functions of packaging are broadly to contain, to protect, and to communicate. An occasional function which may be considered is the service function.

0.4 In this part, various factors which influence the selection of a particular package for a particular product have been enumerated. Before a method of packaging can be selected, a review should be made of the factors concerned with a particular content to be packed, The weightage to be given to any factor may differ greatly between products but these factors may be conveniently classified Under the beadings as given in this code.

0.5 In the preparation of this standard considerable assistance has been derived from BS 1133: Section 1-3:1966 ' Introduction to packaging' issued by the British Standards Institution (BSI).

1. SCOPE

1.1 This standard (Part I) lays down the guiding factors which affect the selection of a package, for a particular product.

2. FACTORS INFLUENCING THE SELECTION OF PACKAGING

2.1 Nature of Contents

2.1.0 The contents may be a single item or an assembly of which the various parts require individual consideration. When any form of multiple packaging is under consideration, the content will often be an item in its own individual pack. In such instances it is important to consider the nature and vulnerabilities of the packed item, particularly when its immediate pack has a display or protective function that should not be impaired.

2.1.1 *Physical Properties* — The size and strength of the package and the containment properties of both container and closure will be influenced by the following basic physical properties of the content:

a) Size;
b) Shape;
c) Mass;
d) Density;
e) Volatility or flammability; and
f) State (liquid, solid semi-solid, powder).

2.1.2 *Vulnerabilities of Content*

2.1.2.1 Vulnerability to impact, crushing or vibration, leading to deformation, breakage or abrasion of surfaces. These primarily influence the selection of fittings and cushioning.

2.1.2.2 Vulnerability to environmental atmospheric conditions leading to:

a) Change of state (liquid to solid, crisp to soft, etc);
b) Discoloration or dirt;
c) Loss of required taste or smell;
d) Acquisition of undesirable tastes or odours;
e) Mould growth; and
f) Corrosion and other chemical change influencing selection of wrappings and/or barriers to moisture, moisture vapour and gases

2.1.2.3 Vulnerability to pilferage.

2.1.2.4 Vulnerability -to. attack by micro-organisms, insects and redents

2.2 Marketing Factors

2.2.1 *Stimulation of Demand*—In retail sales particularly, demand may be stimulated by appearance or by anticipating the recipient's needs in terms of quantity, quality or convenience.

Appearance is influenced by the particular image of the content, or that of the producer, that the package is required to create. Such an image may be linked to publicity supporting the product by colour, design and trade marks and can be designed to convey impressions such as luxury, hygiene, economy simplicity, reliability, dignity or modernity, of the content.

The required appearance and in some instances the effect of its touch may influence what materials are used and the shape of the package.

In general, the needs of the recipient influence the size of the pack, the provision made for convenient opening, dispensing, and sometimes reclosing and subsequent after-use by the recipient and the inclusion of instructions for use or other printed matter.

But wherever stimulation of demand for a product is important new ideas and techniques may be expected and the packaging system selected shall be adaptable to change.

2.2.2 *Satisfaction of Demand*

2.2.2.1 Some products are seasonal in that demand is higher at one time of the year than another; others are sensitive to the stimulation described above, and others to changes in prices of raw materials arising from other factors and so the cost of the product itself. All are subject to variations in demand which can only be met either by a production system which has to be matched in adaptability by the packaging system selected, or by a constant rate of production packaged to withstand the storage period that may now elapse between production and eventual use.

2.2.2.2 Other factors arise from the system of merchandising and many will be concerned with appearance, already considered. The package may also be influenced by the size and arrangement of storage and display shelves at the point of sale.

The protection to be provided against atmospheric hazards will partly depend on the time elapsing between production and final sale or use which can vary greatly with different systems.

Most of all however the system of merchandizing will influence packaging by dictating the destination and hence the distribution system that will be used.

2.3 Distribution Factors

2.3.1 *Distribution* — Distribution of a product can be regarded as a series of handling, transit and storage operations differing from system to system in their sequence, frequency, methods and environment.

Method of distribution will largely be influenced by destination since this controls the type of handling, which may be manual or mechanical of varying degrees of development; and the means of transport (road, rail, sea or air, singly or in combination) that can be used.

2.3.2 *Hazards* — The hazards met by a package in a distribution system will generally be associated with:

a) impact during handling and transit operation,
b) compression during transit and storage when packs are stacked one on another,
c) Vibration during mechanical handling and transit,
d) puncture from other packages or from sharp projections on vehicles, pallets and conveyors,
e) atmospheric conditions of temperature and humidity and pressure, and
f) other environmental conditions such as infestation by rodents and insects, dirt, water and contamination from contents of other packs.

When choosing the package for a particular distribution system the first step will be to compare the hazards of that system with the vulnerabilities of the proposed contents.

Particular hazards, even though they occur frequently and at high intensity may in fact be irrelevant in that the proposed content is relatively invulnerable to them and they can therefore be discounted. There may remain those hazards that shall be considered and, as far as possible, it will be necessary to get some measure of intensity that may be applied to each when selecting and designing the packaging.

In general, a measure of intensity of impact is expressed in terms of the height of drops, for compression, by the load on the bottom pack of a stack and the time in the stack; atmospheric conditions, by maximum and minimum values for temperature, relative humidity and pressure, and the periods for which the package is likely to be exposed to these conditions.

Vibration, puncture .and environmental conditions other than atmospheric are less easily assessed and the degree of protection against their effects will generally be a matter of judgement.

2.3.3 *Limitations* — In any system of distribution there will be limitations on size and mass set by the size of openings, such as doors and hatches, capacity of lifting equipment and, where handling is manual, by the carrying capacity of male, or female labour.

With the trend for distribution systems to become increasingly mechanized and complex, special requirements are placed on the designer of the package. If for convenience of handling, it is required that packages are to be loaded on to pallets, their size shall be such that the pallet load is stable and economical and this dictates the possible sizes of package that may be selected. If the package itself is to be handled by fork lift truck there are dimensional standards of width and fork-entry height to be met. Conveyor belts have dimensional and mass limits.

So far this trend is limited to handling, but as it extends to storage, and as automatic warehousing is introduced, further factors influencing the design of the pack may have to be considered.

2.4 Statute And Regulation

2.4.1 Obligatory requirements that may influence choice or design of packaging shall be concerned with safety, protection of the consumer, the requirements of the carrier, and import control of materials which may be infested.

2.4.2 The provisions of the standards of Weights and Measures Act, 1976 as ammended by the central government to date, lays down the weight or quantity of different products to be packed along with the marking for their retail price. The main purposes of legislation for consumer protection are to prevent deception by misleading description or packaging, and to safeguard the consumer against toxic hazards due to the nature of the content or to interaction between content and packaging.

2.4.3 Regulations concerning the requirements of the carrier are in general issued either by international organizations such as the International Air Transport Association and the Inter-Government Maritime Consultative Organization or by the carrying authorities themselves.

2.4.4 Certain countries have legislation controlling the entry of materials, such as wood and straw liable to be infested by insects and packaging and packages destined for such countries shall conform to such regulations.

2.5 Cost Factors In Packaging

2.5.1 *Distribution Costs* — The costs *of* distribution are generally concerned with the costs of:

a) Freight by mass, volume or nature of consignment;
b) Handling;
c) Stock control and storage;
d) Packing and unpacking, and of replacing or repairing defective items; and
e) Insurance.

For proper economy it is desirable that a correct balance between these be maintained. Reduction of a low damage rate can be achieved by more expensive packaging but still show an overall loss; or the extra cost of increasing the strength of a particular container could be more than off-set by the saving in storage costs by higher stacking and so more economic use of floor area.

2.5.2 *Packaging Cost* — A proper balance should be maintained between the costs directly attributable to packaging. These include costs of:

a) labour and overheads,
b) materials and containers; -
c) maintenance and depreciation of packaging equipment and machinery/ and
d) stock-control and storage of packaging materials.

Probably the biggest single factor lies in the production rate required since this indicates the point at which hand operation becomes uneconomic and the correct balance between labour and machinery costs is obtained.

Labour costs are generally based on the use of relatively unskilled labour and, for this reason and the difficulty of inspection after final closure, it is important that the packaging method employed be simple. Where simplicity is impossible, the design should be so arranged that fittings, etc are capable of insertion in one way only, or that the package cannot be closed if incorrectly assembled.

The initial cost of some types of containers is particularly influenced by the size of the order placed, to the point where small orders are quite uneconomic. As requirements increase there may be economic advantage in the cheaper rates for bulk buying, while awaiting use, but on the other hand they are to be stored and the cost of this depends not only on numbers but also on the space taken by each container.

Where the special requirements of the content require a complex or expensive design of package or when the distribution system can be closely controlled, as for example, direct and constant supply from one factory to another economy should be considered by comparing, on a one-trip basis, the initial cost of a non-returnable with the depreciation, loss, maintenance, and return-freight costs of a returnable container.

2.5.3 *Capital Costs* — Many of the costs mentioned above can be seen to include a capital element as, for example, the costs of buildings in which packaging materials are stored or used, machinery and materials handling equipment. Where goods are of high value, the relative costs of rapid and slow transport in terms of the costs of the capital tied up in their value may need to be considered.

3. SELECTION OF PACKAGING METHOD

3.0 Once the factors which influence the selection of packaging have been assessed in the context of a particular product the actual problem of package design can be tackled; It is usually convenient to consider the problem in terms of the several functions required of the package. Containment can be considered as part of protection for this purpose, but it should be remembered that in addition to providing protection containers facilitate handling and may be necessary for this reason alone (for example, for liquids).

3.1 Design For Information — It is obvious that the package shall convey to the recipient or prospective buyer all the information necessary to identify the contents together with any warnings (for example, for hazardous products) and further information required by statute or which the manufacturer wishes to impart (for example, instructions for use). Transit packages shall also bear consignment markings *(see* IS: 1260)*.

Another and most important role for many commercial packages is to advertise the product. A package which is convenient to display and is pleasing in terms of shape, size, colour *(see* Note) and surface finish can do much to 'sell* the product. These aesthetic and practical aspects of package design are not really within the scope of this Code but should always be borne in mind in package design, and for detail packages in particular they may largely determine the nature of the package.

NOTE—The choice of colour or colours for a display package may be of significance in the context of such factors as 'brand image' association of the brand with quality and reliability. It may be important therefore that maintenance of the colour in production runs should be achieved.

•Pictorial markings for handling and labelling ofgoodw
(Part I)-1973 Dangerous goods *(first r$viswn)*
(Part II).1973 General goods *{firstrevision).*

3.2 Design For Protection — There is often more than one way of affording the necessary protection to an item, in order to withstand the hazards of handling, transport and storage.

By following certain general principles the task can be simplified* First consider the item from the point of view of its vulnerability to:

a) climatic hazards;
b) physical hazards; and
c) special hazards, for example, attack by pests or micro-organisms.

Sometimes there is not a clear line of demarcation and sometimes a container may provide both climatic and physical protection. It is helpful to approach the selection of the packaging technique by considering the most difficult of protection problems first and then to solve the others, having due regard to the two rules that it is usually preferable to effect climatic protection as close as practicable to the contents and that it is essential for all the constituents of the completed package to be compatible with each other and the contents, unless suitably insulated. **For** checking the compatibility of any product with the packaging materials the practical tests can be the actual storage of the product into the intended container for its expected shelf life under the ambient temperature and humidity conditions. In some cases accelerated conditions of testing help to ascertain the long term behaviour of the contents in a package.

Most forms of packaging involve enclosing the contents by wrapping or placing in a container or both. The consequent elimination of ventilation may well increase the possibility of deterioration and emphasizes the importance of cleaning the item as the first step in
packaging.

4. PRESERVATION

4.1 Materials — The principal materials used, either alone or in combination, in the preservation of contents are:

a) Barriers (including containers):
b) Contact inhibitors,
c) Desiccants,
d) Preservatives,
e) Primary wrappings,
f) Temporary protectives, and
g) Volatile corrosion inhibitors (v.c.i.).

4.1.2 *Barriers* — Barriers may well be provided by the choice of a suitable container, for example, glass, metal, plastics, etc. Alternatively, if the container material is inadequate as a barrier the barrier may be of sheet materials usually chemically inert made up in the form of sealed bags, envelopes, etc. Often their function is to control the transmission of water, water-vapour, gases or light.

4.1.3 *Contact Inhibitors*—These are substances the aqueous solutions of which can inhibit the corrosion of ferrous metals and certain non-ferrous metals.

4.1.4 *Desiccants* — These are substances, usually granular in form, which absorb moisture and retain it at ambient temperatures. They are enclosed together with the item, within sealed water-vapour resistant/proof barriers. The desiccant is supplied in bags which should be disposed uniformly (using if necessary a number of small units rather than a single large unit) and it is important they are secured in position to minimize the chances of desiccant dust escaping.

Their function is to limit the relative humidity within the barrier, normally to a maximum value of 50 percent.

The quantity of desiccant required is dependent upon the permeability of the barrier material to water-vapour, the amount of moisture enclosed within the barrier at the time of sealing, and the duration for which the protection is required.

4.1.5 *Preservatives* — Preservatives are compounds applied direct to non-metallic constituents. They may be surface coatings only or there may be a degree of impregnation. Their function is to prevent deterioration of a chemical nature or attack by micro-organisms, insects, etc.

Normally preservatives once applied cannot be removed. Often they are applied in the course of manufacture.

Because of the irreversible nature of most preservation processes for non-metallic materials it is especially important that the package designer should consult the product designer before specifying a preservative treatment.

4.1.6 *Primary Wrappings* — Primary wrappings are usually chemically inert materials, applied in the form of sheets, bags, envelopes or tubes. Their function is to prevent:

a) contamination of contents by external agencies (for example, dust, dirt);
b) contamination of goods by contact with packaging* materials; and
c) contamination and displacement of the temporary protective (or preservative) compound.

4.1.7 *Temporary Protectives* — Temporary protectives are compounds applied direct to metallic surfaces to prevent water or water-vapour coming into contact with the surfaces and causing corrosion. Normally temporary protectives should be removed before goods are put into use. They fall into the following basic types:

a) Hard films, applied by dipping or spraying;

b) Soft films, such as, lanolin, applied by dipping or spraying;

c) Soft, thick film, usually based on petrolatum, applied by hot dipping;

d) Soft grease films, normally applied by brushing or smearing;

e) Oil films generally applied by dipping, spraying or circulation (serving as lubricants as well as temporary protectives); and

f) Hot-dip strippable coating, consisting of ethyl cellulose and small amounts of mineral oil, applied by hot dipping.

For particulars of temporary protectives *(see* IS : 6049-1971*).

4.1.8 *Volatile Corrosion Inhibitors* — Volatile corrosion inhibitors (v.c.i.) are .substances which when present as a vapour, inhibit the rusting of ferrous metals.

4.2 Preservation Techniques — There are three main techniques of preservation against moisture. For some items it may be necessary to retain moisture by choosing a barrier to control loss. For other uses the transmission of gas will have to be controlled.

The first method is to employ a temporary protective or preservative alone. This is appropriate for items having constituents which can be completely protected by the application of temporary protective or preservative. This usually means items of relatively simple construction in which parts subject to deterioration are readily accessible to the application of the temporary protective (and its subsequent removal before use if necessary) or preservative.

The second method is to employ a barrier with or without a temporary. protective or preservative. This is appropriate for items having susceptible constituents which cannot all be protected or cannot be completely protected by the application of temporary protective or preservatives, but for which enclosure in a barrier affords the necessary additional protection.

♦Code of practice for application of temporary corrosion preventives.

These may be metallic items of some complexity with inaccessible surfaces where at best only a light oil can be applied and the addition of a waterproof or water-vapour proof barrier augments the protection to the desired level. For some metallic items with protective treatments applied in manufacture a barrier alone may suffice. It should not however be assumed that protective treatments which are satisfactory for an item when in use will be equally effective in preventing deterioration of an item inside a package (when there may usually be no ventilation).

Non-metallic items, whether treated with preservatives or not, will usually require the added protection of a barrier if they are liable to be exposed to severe climatic conditions. No hard and fast rule can be laid down for choosing between a barrier which is merely waterproof and one which is water-vapour proof or at any rate highly resistant to the passage of water-vapour. A waterproof barrier will limit direct ingress of liquid water but may well allow sufficient water-vapour through to result in the formation of liquid water inside the barrier when subsequent condensation occurs. A water-vapour barrier will retard the amount of vapour getting through so that condensation is much less likely and may be prevented altogether. The choice should hinge therefore on whether or not the item, preserved as far as practicable, would deteriorate if droplets of water were to form and remain on the item for some time. It should also be borne in mind that there may be some products for which it will be necessary to control egress of water.

The third method is to employ a barrier highly resistant to the passage of water-vapour and to enclose within it a desiccant. This is appropriate for items having susceptible constituents which cannot be treated with temporary protectives or preservatives and for which enclosure in a barrier alone is insufficient protection. It is particularly applicable to complex items, especially those with a mixture of metallic and non-metallic components. It is an important virtue of this technique, and one which often leads to its choice, that unpacking entails no cleaning process.

5. PHYSICAL PROTECTION

5.1 Types of Containers — Certain items, by virtue of their simple and robust construction, require no packing other than bundling or wrapping to simplify handling. In other instances, only vital parts of projections need to be specially protected or cushioned. For most items or products the provision of physical protection will entail some form of container. For commodities other than liquids, powders, granules, etc, which take up the shape of the container, it is usually also necessary to provide a method of locating the item within the container and perhaps insulating the item to some degree from the shocks which the package receives. The types of container in common use are described below.

5.1.1 *Glass Containers* — Glass containers are available in forms, such as, jars, bottles, ampoules, etc. They can be produced in any colour and ranging from transparent to opaque and can be specially made to possess precise properties of absorption to light of particular wave-lengths, X-rays, etc. Completely impermeable to water and water-vapour glass is highly resistant to all liquids and may be specially compounded to resist extreme chemical attack. Its general inertness, combined with the fact that it lends itself to sterilization process, makes glass very suitable for applications in the field of foodstuffs, medical and pharmaceutical supplies. Glass containers being rigid, although reasonably resistant to impact shocks, usually require to be additionally protected for transit.

5.1.2 *Metal Containers* — Metal containers are made in a wide range of sizes. The most common shape is the cylinder but rectangular shapes are also available. Tins and cans are usually made of tinplate or aluminium. Drums are usually made of mild steel. Aluminium, tin, lead, or alloys of tin, are the basic material from which collapsible tubes (for example, toothpaste tubes) are manufactured.

A wide variety of surface coatings or treatments may be applied internally and externally to meet special requirements (for example to render the container resistant to corrosion or to prevent contamination of the contents). Metal containers have the advantage in that they provide both physical and climatic protection and are very suitable for liquids, semi-liquids and powders.

5.1.3 *Paper and Board Containers* — Paper and board containers include cartons, rigid boxes, tubes, drums, moulded pulp, boxes and cases manufactured from solid fibreboard or corrugated board. Their use has the following advantages:

a) The materials employed can be of specified strength, chemical purity and water resistance and are of light mass;
b) They can be made in a variety of styles and shapes;
c) They are easy to handle and assemble; and
d) They can be manufactured to be collapsed, when empty, to facilitate transport and storage.

Closure of paper board containers is normally effected by overwarp-ping, heat sealing, stapling, use of adhesives or adhesive tapes. Fibreboard containers, solid or corrugated, the latter in double-face Or triple wall are used increasingly for transit cases.

Paper bags and sacks are manufactured in a wide range of shapes and sizes, for a variety of materials and substances. They may be of single ply, duplex or multi-ply and may be reinforced with other materials.

It is thus practicable to provide a great variety of properties, such as grease-proofness, high wet strength, water-proofness, etc, and so meet specialized requirements for many products. Methods of closure include folding of the open end, use of adhesives or adhesive tapes, typing, stitching, heat sealing, etc.

5.1.4 *Plastics Containers* — The great variety of plastics materials from which containers can be made and the several processes of manufucture, principally moulding, thermo-forming and extrusion, including fabrication from film, make it practicable to produce plastics containers with widely varying properties. Selected characteristics can be produced in terms of physical strength, flexibility, rigidity, opacity, transparency and degree of permeability or impermeability to almost any vapour or liquid, the range of choice being enormous. Generally speaking, the use of moulded or thermo-formed plastics containers is more justifiable when large quantities are required.

5.1.5 *Wicker and Veneer Baskets* — These are available in a variety of styles, shapes and sizes with and without lids, suitable for the physical protection of a wide range of commodities. They are light in mass for the strength which they possess.

5.1.6 *Wooden Containers*— Containers may be constructed of timber, plywood, or combinations of these and are available in a variety of styles and forms of construction such as:

a) Large wooden containers, that is, a frame sheathed with timber or plywood;
b) Small wooden cases of batten and board construction;
c) Plywood cases (battened construction);
d) Plywood cases (metal-edged construction);
e) Wirebound boxes and crates;
f) Plywood barrels;
g) Wooden crates; and
h) Comb-jointed containers.

6, SELECTION OF CONTAINER

6.0 Because of the great variety of available containers it is not practicable to lay down precise rules but the following guidelines are suggested. All the factors which influence the selection of packaging, which are outlined in **1** to **5** may need to be considered but choice can be narrowed initially by a consideration of:

a) The performance required of the package; and
b) The size, mass and nature of content.

The performance required of the package is largely dictated by the distribution to which it is subjected. The length and nature of the total delivery journey in terms of the forms of handling, transport, storage and exposure to weather (at transhipment points, for example) are significant. Generally speaking the greater the duration of the journey or the more frequent handling the more rugged the container needs to be. Movement by ship, because of dock handling and stowage in holds, generally makes different demands on containers from movement by road or rail, for example. It is generally recognized that movement by air, taken by itself, imposes relatively mild strength requirements upon containers. Due regard should be paid to the journey hazards arising from the journey to and from the airport. It should not be forgotten that in the case of air movement the pressure stresses due to altitude will have to be borne by sealed containers.

It is essential that the material of container should be easily sealed on conventional filling and packaging machinery.

6.1 Climatic Protection — If in addition to providing physical protection the container is required to 'double-up' as climatic protection, the choice may be directed towards metal, glass or plastics, or one of the other container types fitted with suitable liners.

6.2 Size and Mass — The effect of size and mass of contents upon the choice of container is self-evident. The bigger and/or heavier the contents the greater will be the strength of the container needed in terms of both wall strength and form of construction. There is, however, a further very important factor which results from the form of the contents. Amorphous contents, liquids, powders, *etc* take up the shape of the container (which shall of course be leak-proof) and require no further method of location as already stated. Other contents together with any method of location adopted, impose upon the container a load which is not only a function of the size and mass of the contents but also owes something to the shape and mass distribution of the contents. The form of load presented to the container has been classified for convenience under three types *(see* IS: 1503-1979*).

The significance of easy, average and difficult loads in making choice of container stems largely from the fact that *pro rata* the wall strength required for an easy load is less than that required for an average load which in trun is less than for a difficult load. This is of course due to the support afforded to the walls by the contents in the first two types of load. Indeed with a difficult load it may well be necessary to reinforce die container at points of excessive load concentration.

•Wooden packing cases.

Choice of a particular container should only be arrived at after a close study of those sections of the Code which deal with individual container types.

6.3 Protection Against Other Hazards — Protection against attack by pests, micro-organisms, etc, is necessarily a highly specialized aspect of packaging.

7. LOCATION IN CONTAINERS

7.1 Methods and Techniques — The principal methods of location and the techniques and types of material used are:

a) Space-filling; loose, granular or shreded material;

b) Wrapping; flexible sheet or wadding material;

c) Load-spreading; moulded fitments;

d) Blocking and bracing; fabricated fitments; and

e) Cushioning; resilient pads, sheets or mouldings or spring devices.

It should be noted that materials, although falling primarily into one of these categories, will often also display characteristics of one or more of the other groups. The methods are described in more detail below.

7.1.1 *Space-Filling* — This consists of filling the voids between the item to be packed and the container surfaces, thus holding it central. The weight of the goods and the impact forces are thus distributed over its surface (and similarly over the corresponding surface of the container).

The materials use for space-filling may not withstand high loading without compaction due to their low resilience and general form. Compaction is undesirable as this permits uncontrolled movement of the supply.

7.1.2 *Wrapping* — Wrapping by means of flexible sheet and wadding materials.

7.1.3 *Load-Spreading*—This involves supporting the item over the major portion of its surfaces by fitments conforming to its shape so as to afford a positive form of location. By suitable cavitation of the fitments in the vicinity of the item's weak areas or projections, the loading of these can be avoided.

7.1.4 *Blocking and Bracing*—Blocking and bracing consists of positioning fitments between the item to be packed and the container in the strongest

areas of the goods to distribute the load on both the goods and container surfaces, and the support and strengthen weak parts of the goods. The materials most commonly used are corrugated paper and board, timber, plywood and other wood products, also expanded polystyrene. Where it is necessary to make provision for a water-vapour proof barrier when blocking or attaching an item to a base, concentrations of load on the barrier may be reduced by plywood strips placed between it and the barrier.

The plywood should be prevented from direct contact with the surface of the item by a water proof material and from the barrier by an anti-abrasive material such as felt. Where attachment bolts pass through the barrier an effective seal should be made.

Sharp corners, edges and projections of goods should be covered to prevent abrasion or puncture of the primary wrapping or barrier material. Suitable protective methods are local covering by strips of self-adhesive tape or mouldable waxed wrapping material (secured if necessary by self-adhesive tape) and application of pads of a suitable material.

7.1.5 *Cushioning* — This is achieved by the use of materials and devices which function by deformation, thereby storing and/or dissipating part of the kinetic energy of the item. Materials and devices may be classified into two groups; elastic (resilient) and non-elastic (crushable). It is important that the protection afforded does not deteriorate during the storage life of the package. It follows that if cushioning materials are subjected to repeated impacts, their shock absorbing properties should remain unchanged and therefore non-elastic materials are unsuitable. Shock absorbing materials used include the following:

Bulk Materials — Non-metallic pads, sheets and mouldings.

Spring devices —Helical extension and compression springs, other metallic springs, solid rubber springs.

7.1.6 *Bulk Materials* — The contents are located centrally in an outer container by one of the following methods:

Completely filling the space between cargo and outer container with sheets, of cushioning materials.

Securing individual strips, blocks or other forms of the cushioning material at precise positions on each face of the outer container. (If circumstances dictate the use of exceptionally thick cushions of small area it is possible to improve stability by linking them with stabilizing plates. The plates should be secured to the cushions by means of an adhesive.)

Distributing the load over a sheet cushion whose area is larger than the smaller faces of the cargo by the use of a load spreading platten.

7.1.7 *Spring Devices* — The contents are supported in the outer container by a system of springs. In simplest form this comprises a series of springs attached to each corner of the cargo and the outer container. These may be helical extension springs, but for light cargoes braided rubber cord may be suitable.

Large, heavy, or dense items are usually attached to a strong framework which is supported by shock absorbing mountings.

NOTE — Adequate provision for the damping of spring systems must be made where this property is not inherent in the mountings.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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